
PROPULSION DIRECTORATE

Monthly Accomplishment Report February 2005

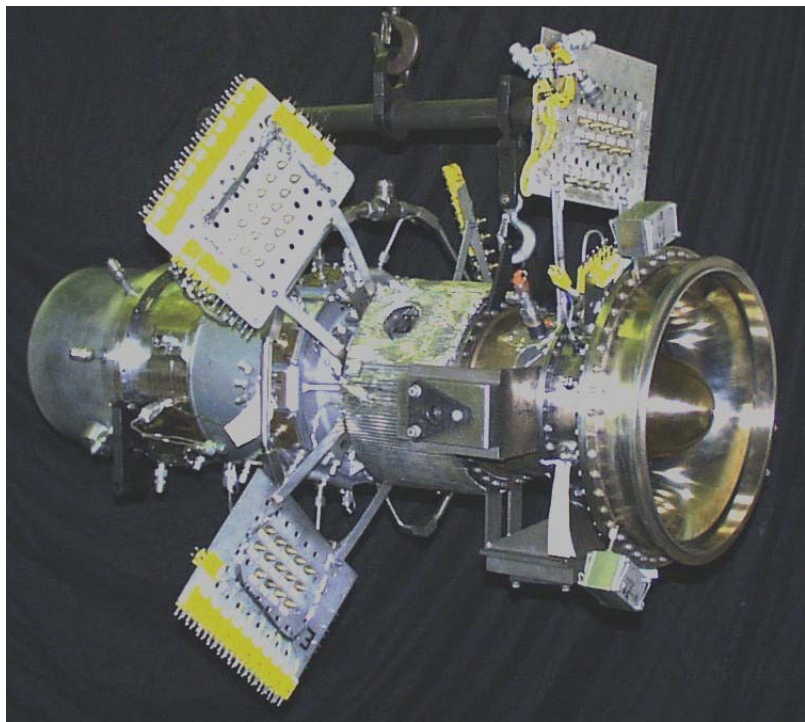


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TESTING OF SUPERSONIC DEMO ENGINE COMPLETED: Testing of the XTL17/1 supersonic demonstrator engine was successfully completed on 4 March 2005 at an Allison Advanced Development Company/Rolls Royce Corp test facility in Indianapolis, Indiana. The mechanical checkout test was successfully completed on 1 February 2005, and subsequent data analysis and fine tuning of parameters and limits led up to the successful 4 March 2005 engine test. Preliminary estimates indicate that the XTL17/1 demonstrated a 93.4% increase in specific thrust, nearly achieving the Integrated High Performance Turbine Engine Technology (IHPTET) Phase III goal of a 100% increase in specific thrust. This result makes the XTL17/1 the highest specific thrust expendable turbine engine ever run. The XTL17/1 is part of the Joint Expendable Turbine Engine Concept (JETEC) portion of the IHPTET Program, which demonstrates expendable and limited life engine technologies for applications such as cruise missiles. Demonstrators such as the XTL17/1 provide low risk technology transition, resulting in high readiness and increased safety and performance for the warfighter. (Mr. S. Sepeck, AFRL/PRTP, (937) 255-1466)



The XTL17/1 JETEC demonstrator engine

IN-HOUSE EFFORT DEFINES IMPROVED SCRAMJET FLOWPATH: The Propulsion Directorate's Scramjet Alternate Flowpath Team recently developed a high performance alternative engine for the baseline Scramjet Engine Demonstrator (SED). This alternate engine exhibits potential for significant improvements in both combustion efficiency and operability compared to the baseline SED engine. The team completed computational and physical experiments at low Mach numbers, along with full CFD simulations at high Mach numbers, to significantly reduce the risk of the high visibility SED Program. This work considerably increases the probability of a successful SED flight demonstration, which is essential for proving the technical feasibility of using hypersonic propulsion for cruise missiles. The successful development of a hypersonic cruise missile will provide much needed capability to the military in successfully prosecuting time critical and deeply buried targets. The alternate engine design has also proven to be very robust at low Mach numbers. This is a critical attribute for a combined cycle engine where a low take-over Mach number for the scramjet is essential for success in applications such as sustained hypersonic cruise and space access. In addition to providing an important risk reduction backup configuration to the SED, the alternate flowpath engine configuration also provides a reference for the future development of larger, broader operating range engines under PR's Robust Scramjet Program. This work was honored as the

FY05 1st Quarter Propulsion Directorate In-House Project of the Quarter. The winning team is comprised of Drs. Mark Gruber, Doug Davis, Dean Eklund, Mark Hagenmaier, and Dan Risha, Capt Adam Fink, and Mr. Stephen Smith of AFRL/PRA; Dr. Tarun Mathur, Messrs. Gary Streby, Charlie Smith, William Haendiges, and Jacob Diemer of Innovative Scientific Solutions, Inc (ISSI); and Drs. Susan Cox-Stouffer and Jiwen Liu of Taitech. (Lt Col J. Haralson, AFRL/PRA, (937) 255-7105)

TESTING VALIDATES NEW SMOKE MEASUREMENT SYSTEM: The Propulsion Directorate's Turbine Engine Smoke Measurement System was recently validated through comparison with similar smoke measurement systems. Smoke samples were obtained from a CFM56 combustor operated at PR's High Pressure Combustion Research Facility (HPCRF) and in field tests on a J-12 aircraft engine at Middle Tennessee State University (MTSU), Murfreesboro, Tennessee. In the HPCRF test cell, combustion generated exhaust smoke samples were collected using three devices: the improved system, an older system acquired by PR in 1977, and a proprietary system owned by General Electric. The measurement systems were operated in both low and high pressure modes to assess the influence of the sampling system on soot formation, and all of the data confirmed agreement to within the accuracy specified for the measurements (i.e., ± 3 smoke numbers). In the testing at MTSU, engine smoke samples were collected in collaboration with personnel from Arnold Engineering Development Center (AEDC). The AEDC team directed the engine testing to compare the new smoke console data with that obtained using their traditional smoke system and an optical method. Smoke levels were assessed at various engine power settings, and the results showed excellent agreement, thus anchoring the test protocols between the laboratory and test center. This comparative test will support pollutant emissions test practices used for both developmental purposes at Air Force Research Laboratory (AFRL) and for full engine emissions testing to be accomplished on the Joint Strike Fighter (JSF) engine at AEDC. Quantification of gaseous and particle emissions may determine the basing of JSF aircraft throughout regions of the US since the levels of engine particulates emitted may restrict basing at some locations due to environmental considerations. This effort was supported by the University of Dayton Research Institute (UDRI) and AdTech. (Messrs. C. W. Frayne, D. T. Shouse, and C. T. Neuroth, and Ms. A. C. Lynch, AFRL/PRTC, (937) 255-6250; Mr. E. Strader, UDRI; and Mr. C. T. Greene, AdTech)

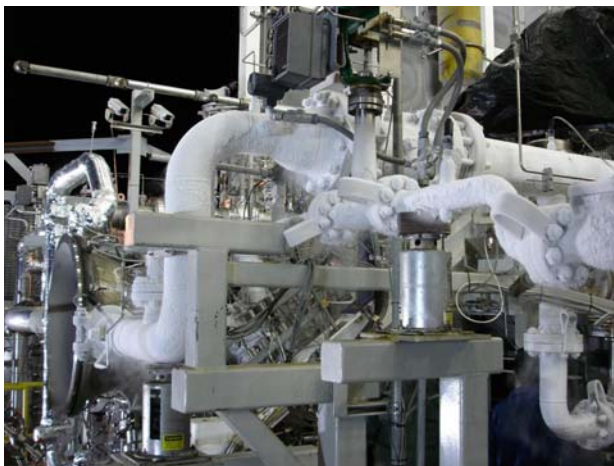


PR's new smoke measurement system

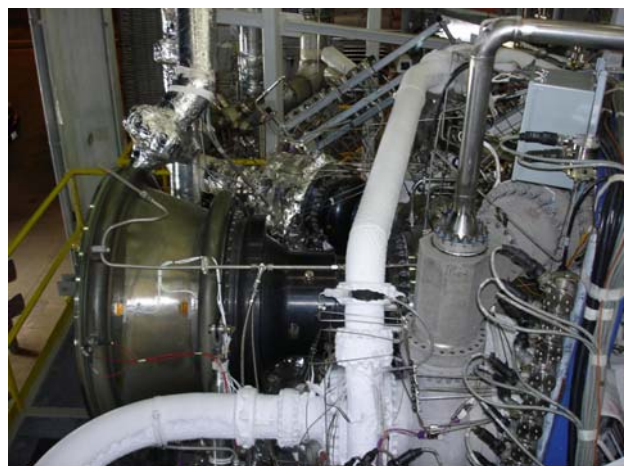


Emissions testing setup at Middle Tennessee State University

INTEGRATED POWERHEAD DEMO TESTING INITIATED: The Propulsion Directorate recently initiated Engine System Testing for the Integrated Powerhead Demonstration (IPD). This test program will validate the start transient and steady state operation of the world's first full flow staged combustion cycle engine. Engine system testing commenced with initial "Cold Shock" of the engine separately with both fuel and oxidizer. As testing proceeds, ignition activation tests will be completed followed by testing to examine the start transient and steady



The IPD engine undergoing cold shock tests



state engine operation. The IPD Program addresses the DoD/NASA vision and commercial needs to operate a highly reliable and long life rocket engine system with significantly reduced operational costs. Through the utilization of a full flow staged combustion cycle, the IPD engine can achieve life and reliability 10 times greater than the Space Shuttle Main Engine. The technology embodied in the IPD engine, such as Revolutionary Hydrostatic Bearings, Single Piece Turbine Blisk and Damping, HIP bonded High P_c Main Combustion Chamber, Channel Wall Nozzle, Gas-Gas Main Injector, Uniform Drive Gas with Platelet Injector design, Oxygen Rich Preburner, and Oxygen and Hydrogen Compatible Materials, can be used for both long life reusable systems and highly reliable low cost expendable rocket engines. The IPD Program will ultimately satisfy the Integrated High Payoff Rocket Propulsion Technology (IHPRT) Phase 1 Cryo Boost goals. (Mr. S. Hanna, AFRL/PRSE, (661) 275-6021)

AFFILIATE SOCIETIES COUNCIL HONORS

TECHNICAL LEADERS: The [Affiliate Societies Council of Dayton](#) held its 46th Annual Outstanding Engineers & Scientists Awards Banquet in Dayton, Ohio, on 24 February 2005. The prestigious Outstanding Engineers & Scientists Awards are meant to recognize ingenious contributions to society in categories such as research, technical leadership, manufacturing, and education. Two of the twelve honorees at this year's ceremony were honored for their work with the Propulsion Directorate. Mr. William E. Harrison III, Chief of PR's Fuels Branch, was honored for technical leadership as was Dr. Alan Janiszewski (Colonel, USAF, ret),* who served as PR Director from 2000 to 2003. Established in 1969, the Affiliate Societies Council consists of about 50 engineering and science-related professional societies whose combined membership in the Dayton area exceeds 15,000. The members of those societies and their delegates to the Council provide the core of volunteer individuals for accomplishing the mission of the Council, which includes: (1) providing professional education opportunities for the general engineering and scientific community, (2) offering career guidance in the various fields of engineering and science, (3) making available the combined expertise of the affiliated societies to the community to assist in solving problems of a technical



Mr. William E. Harrison III



Dr. Alan Janiszewski

* Dr. Janiszewski is currently employed by Universal Technology Corp.

nature, and (4) providing administrative services for affiliated societies to promote continuity in society management and a close working relationship among societies. (Col M. Heil, AFRL/PR, (937) 255-2520)

NEW AIAA ASSOCIATE FELLOWS IN PR: Four Propulsion Directorate employees were recently named Associate Fellows of the American Institute of Aeronautics and Astronautics (AIAA). These four new AIAA Associate Fellows are Drs. Joseph Zelina, Robert Hancock, Mark Gruber, and Jordi Estevadeordal.[†] Nominees for the position of Associate Fellow must be Senior Members of AIAA with at least 12 years of professional experience. Three references from AIAA members with the standing of Associate Fellow, Fellow, or Honorary Fellow are also required to support the nomination. Furthermore, nominees must have contributed to the advancement of the organization, including speaking at or attending technical conferences, taking charge of important engineering or scientific work, or performing original work of outstanding merit. The mission of AIAA is to advance the arts, sciences, and technology of aeronautics and astronautics and to promote the professionalism of those engaged in these pursuits. (Col M. Heil, AFRL/PR, (937) 255-2520)

Want more information?

- ❖ A *Skywrighter* article on the new AIAA Associate Fellows is available here:
<http://www.skywrighter.com/people/2005/0114/8afrlfellows.asp>.
- ❖ A list of the new AIAA Associate Fellows for 2005 is available here:
<http://www.aiaa.org/content.cfm?pageid=249&lugradecode=MC>.



Dr. Mark Gruber



Dr. Robert Hancock

[†] Dr. Estevadeordal is an on-site contractor with Innovative Scientific Solutions, Inc.



Dr. Joe Zelina



Dr. Jordi Estevadeordal